UNIVERSITY OF PENNSYLVANIA

The Ten Year Level of Competency

MILES MURPHY

A THESIS
IN PSYCHOLOGY

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

PHILADELPHIA
1928

The Ten Year Level of Competency

A THESIS
IN PSYCHOLOGY

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL OF THE UNIVERSITY
OF PENNSYLVANIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

MILES MURPHY

Reprinted from
The Psychological Clinic, Vol. XVII, Nos. 2-3

PHILADELPHIA
1928

R. UNIV.
BIBLIOTHEEK
LEIDEN

The Psychological Clinic

Copyright, 1928, by Lightner Witmer, Editor

VOL. XVII, NOS. 2-3 MAY-JUNE, 1928

THE TEN YEAR LEVEL OF COMPETENCY

MILES MURPHY, *University of Pennsylvania*

INTRODUCTION

Leaming[1] has determined the standards of performance for the fifteen year age level. This level, which Leaming points out must not be restricted by arbitrary limits of chronological age, represents "the age of physical maturity . . . . when the child begins to be considered a unit member of society. Easby-Grave[2] has determined standards for the six year old performance level. At this age level "the criterion of competency is the child's congenital and potential ability to respond to educational and other stimuli with some change of behavior directed toward a definable level of social proficiency."

The standards determined by these investigations have been used successfully for purposes of diagnosis at the Psychological Clinic of the University of Pennsylvania. The results of the study of the fifteen year age level have provided standards for the comparison of the performances of children from fourteen to eighteen years of age, speaking somewhat approximately, while the results of the study of the six year level have been used for children who are about to enter school or who are still in the early grades of the school system, from five to eight years of age or thereabouts. There remained, however, a large group of children intermediately situated both in school progress and chronological age, for whom no adequate standards of comparison existed. It was, therefore, decided to investigate the competency of an intermediate age level, and for such a study the ten year level seems a logical one.

[1] LEAMING, R. E., *Tests and Norms for Vocational Guidance at the Fifteen Year Old Performance Level.* PSYCHOLOGICAL CLINIC, 1923, vol. 14, pp. 193-220.

[2] EASBY-GRAVE, CHARLOTTE, *Tests and Norms at the Six Year Old Performance Level.* PSYCHOLOGICAL CLINIC, 1924, vol. 15, pp. 261-300.

In the study of an age level one of the first problems demanding consideration is the selection of a group of children to serve as subjects for the tests which are to be used. In the present study the problem was to secure a group of children who would be representative of the ten year level. Indeed, one might well begin with the question, "What is a ten year old child?" From a practical point of view for the present investigation a precedent had been established in the work done at the six year level. For that study children who were in the First Grade of the school system were chosen, although the chronological ages of the children so chosen ranged all the way from four to eleven years. Following the plan of the previous work it was decided for our investigation to test children who had reached the Fifth Grade of the elementary schools. In the regular course of school progress these children should be approximately ten years old; actually, as reference to the table of chronological age will show, they varied in age from eight to seventeen years.

A single precedent is admittedly an inadequate justification for such chronological heterogeneity in a group which purports to represent the ten year level. A further analysis of the problems involved in the selection of cases for study at a given age level seems necessary. These problems are both practical and theoretical. It is conceivable that an investigation might be organized in such a manner that a sufficiently large number of children could be tested exactly on their tenth birthday. This procedure, though conceivable, does not recommend itself as very practicable, and, as we will endeavor to show, it is by no means certainly correct from a theoretical point of view. Practically such an investigation would be extended over a prohibitive length of time, or an unmanageable number of workers would be required. If children are not to be taken exactly on their tenth birthday the question arises, "Would one day make a difference? Two days? A month? Six Months?" Surely a difference of one day is immaterial. One month is considered to be a significant differential in calculating the Intelligence Quotient by the Binet-Simon test. But is it significant? And how do you know? The group might be limited by taking children who are ten and not eleven years old, or those who are between nine and one-half and ten and one-half years of age. There is no particular justification for such arbitrary procedure, and besides some children falling

into the category decided upon might be missed—those in institutions for the feebleminded, for example. The difficulty involved in drawing so definite a line of chronological demarcation is so great as to make it a matter of serious question whether the end result would provide adequate compensation for the pains taken.

It might be contended that for such a test experiment a more homogeneous group of cases is necessary. That may well be true, but what shall be the criterion of homogeneity? A group of ten year olds chosen by the elaborate method of testing them on their tenth birthday would be no more homogeneous than the group tested in this study. They would be found in the school system all the way from the First Grade to the Sixth, Seventh, or Eighth, perhaps even in High School, so efficient is the school machine becoming. The children in the Sixth Grade are certainly quite unlike those in the First, chronological age notwithstanding. If the vigor of a tree growing by a stream is to be determined should it be compared with another tree of the same age growing on a dry hillside or with another tree growing by the stream whatever its "chronological age" may be? The child in the Sixth Grade has been living by the stream of knowledge—if so weak a figure will bear extension—for a much longer time. Six grades in school surely provide some intellectual nourishment.

It must always be remembered that the purpose of this investigation is to secure standards which can be used for the purpose of diagnosis. Most children brought to a psychological clinic are brought for the determination of mental status, and if that status is to be determined by the method of comparison, than which there is no other, the child should be compared with children who have, under ideal circumstances, the same chronological age, the same health, the same physiological development, the same home environment, same social status, same school training and so on. For such a comparison the standards secured from the chronologically homogeneous group of children chosen so carefully to be tested on their tenth birthday would be of little value. All that could be accomplished by such painstaking selection would be to take one factor in the problem of homogeneity, namely that of chronological age, and exaggerate it into an importance which it does not merit. It has long been recognized that time is a very inaccurate measure of age, and in medicine, as Dr. White points out, the fallacy of the chronological criterion is well ex-

pressed in the familiar saying "a man is as old as his arteries."

It is not claimed that the children of the Fifth Grade tested in this study constitute a homogeneous group, not even homogeneous in the matter of school proficiency. The Fifth Grade of a school system represents some children who have been pushed along because they fit the seats of the school room, and also some who are wasting their time listening to the feeble efforts of their stupid fellows. Testing a large group of children by so thorough a method as the one outlined here is an arduous piece of work. The method of selection employed is an eminently practicable one, and from a theoretical point of view it is not open to more serious objections than can be raised against any other. The fact remains that no matter how a group is chosen for the determination of standards or how the results are treated statistically, the psychologist who acts as diagnostician, if he is to deserve the name, cannot escape the onus of thinking. All that the results of this investigation can do is to provide him with a tool wherewith, granted he has the congenital aptitude and a measure of experience, he may think somewhat more discerningly and perhaps more effectively.

After the group of children who are to serve as subjects for study of the ten year level has been selected we can be concerned with a differentiation of this level from the two age levels previously studied. The normal fifteen year old should be able to take his place in society and make some sort of living, in many cases not a very good living, of course, but at this age the individual should support himself or should have proved himself worth the investment of further training and education. Such performance is manifestly impossible for the normal six year old. There are exceptions to be sure, the child may be a musical prodigy or a circus freak, but the six year old is in all but a negligible number of cases a dependent member of society. The fifteen year old is in most cases post-pubescent and has experienced the physical and emotional concomitants of physiological maturity. The difference between the six year old and the fifteen year old is a pre-analytic one. When the ten year old is compared with these two age levels he is seen to be more like the six than the fifteen. The difference between the ten and the fifteen year old is also pre-analytic; the difference between the ten and the six year old is post-analytic.

The differences existing between these three age levels can be explained more definitely by reference to the efficiency of each.

The word "efficiency" is used with two meanings. In one sense it refers to the relation between an effect produced and the energy expended in producing it. This is a specific mechanical concept. In another and more general sense, efficiency is the ability or power to produce effects, that is, effectability. It is in this latter sense that the corresponding adjective is used in the philosophical term "efficient cause."

The six year level is the level of human competency. It is only at this age that the child is fully born; his potential abilities are demonstrable as they are not at an earlier age. Six year old children, then, have liminal human efficiency, but they have subliminal social efficiency. This is in essence the argument presented above. Fifteen year olds have liminal social efficiency, that is, they are able to produce enough effects to put them over the threshold of social acceptability. Efficiency is used here in its more general meaning, as will be observed. Ten year olds, like six year olds, have subliminal social efficiency. They have supraliminal human efficiency. The distinction between the ten year level and the six year level lies in still another field, that of intellect. The six year old goes to school with his human efficiency in order to raise his intellectual level. The coherent competency which makes possible his human efficiency becomes differentiated through surpassing intellectual levels. By the age of ten years or thereabouts the child has raised his intellectual level to such a point that he may be said to possess liminal intellectual efficiency. In order to have complete social efficiency he needs to develop only in physical growth and emotional responsibility. In the public schools of Pennsylvania children are required to pass the Sixth Grade of the elementary school in order to secure a working permit unless they are sixteen years of age. This is one grade higher than the children tested in our study, but an acquaintance with the vagaries of promotion in the schools leads one to attach less significance to this one grade of difference than would at first seem necessary. The ten year old, therefore, is one who has supraliminal human efficiency, liminal intellectual efficiency and subliminal social efficiency.

Procedure

The group of subjects who were tested in this study consisted of 500 children in the 5A and 5B Grades. Of these 500 children 272 were in the schools of a township lying just a few miles out-

side the boundaries of the city of Philadelphia. This township has eight elementary schools which vary greatly in size. In the largest school there were 90 pupils in the Fifth Grade, in the smallest school there were only 18 in this grade. Most of the communities are new and the school population has increased very rapidly within the last few years. It was frequently impossible to secure complete school records for the children because they had been transferred from schools in the city and elsewhere. The children in the township schools came mostly from the homes of tradesmen and office workers, but there were some children of professional men and also some children of servants. A very few were children of farmers. Practically all social levels are represented in this group. Not quite 10 per cent were colored. Every Fifth Grade pupil of the township was tested and of the entire number 135 were boys and 137 were girls.

The remaining 228 cases came from two of the public schools of Philadelphia. These two schools were chosen because taken together they appeared to give a fair cross section of the population of the city, and they were geographically convenient to the persons engaged in making the study. The smaller of these schools supplied only 97 cases. It was located in a residential neighborhood, the social level of which was perhaps slightly above the average. The other school, in which 131 children were tested, is in a neighborhood of row houses and small stores. In this latter school about 20 per cent of the children were colored. Of the city children 115 were boys and 113 were girls. A preliminary investigation showed that the sexes were about equally divided in the Fifth Grade. The statistical treatment of the results in order to show sex differences, if any exist, is made much simpler by having an exactly equal division of the sexes in the group studied. It was decided at the beginning of the study, therefore, to test an equal number of boys and girls. Because the division is so nearly equal, no inaccuracy is introduced by this concession to convenience.

Of the entire group of 500 children 44, or not quite 10 per cent, were colored. Beyond this no effort was made in the direction of racial analysis since that was not really the aim of the work. The colored children, however, constitute a somewhat more definite group, and it is planned to discuss their results in a subsequent paper.

This investigation was conducted under the direction of Dr.

Lightner Witmer and through his inspiration. To those who are acquainted with his orientation in psychology my indebtedness to him will be apparent throughout both the prosecution of the work and its discussion. This study is only a small part of the work which he has conceived for the purpose of determining diagnostic criteria at different age levels.

The group of persons who assisted in the necessarily extended and tedious labor required for the actual testing included: Mr. Carl Altmaier, Assistant in Psychology; three members of the staff of the Psychological Clinic—Miss Genevieve McDermott, Clinic Teacher; Miss Helen Roberts, Recorder; Miss Lorraine McNally, Assistant Social Worker—and Miss Helen Matthews, Graduate Student in Psychology. These assistants were all thoroughly trained in the theory and practice of mental testing.

The study was begun in October of 1926 and was completed in February of 1927. The writer was present at all the examinations and saw each child personally some time during the course of his examination.

In selecting the battery of tests to be employed in an investigation of this kind there are two important desiderata. First, the number of tests must be large enough and sufficiently varied to provide a reasonably accurate index of the subject's performance. Second, that number must not be so large as to be impracticable either in the investigation itself or in subsequent individual examinations in which the results of the investigation are to be used as norms. The battery of tests selected for this study is somewhat smaller than that used for the investigations of the six year level and the fifteen year level. This change was made because the workers engaged in the previous standardizations both reported that too much time was required by the tests which they employed. The tests which were chosen for the present investigation include all those used regularly for purposes of diagnosis in the Psychological Clinic. Taken together, they provide, we believe, adequate opportunity for forming both qualitative and quantitative judgments in the case of an individual child at this age level.

The tests selected were the following: Witmer Formboard, Witmer Cylinders, Dearborn Formboard; audito-vocal memory span forward, visual-vocal memory span forward, audito-vocal memory span reverse; the Stanford Revision of the Binet-Simon Intelligence Scale; and an arithmetic test.

Three of these tests, viz., the Witmer Formboard, the Witmer Cylinders and the Dearborn Formboard, are commonly known as performance tests. This term, while it may be a useful one in distinguishing these tests from others, certainly is neither definite nor accurate. When a child's memory span is tested he responds with what must surely be called a performance. The behavior of a child in response to the multiform demands of the Binet-Simon test likewise involves a performance, however disconnected, disorganized and heterogeneous the constituent elements of the performance may be. Tests of this kind are sometimes known as "mechanical" tests, and as a matter of fact many of those who call them performance tests invest the term "performance" with this connotation. In individual cases these tests may be mechanical, but the fact of their being mechanical is resident in the operations of the individual subject and not in the nature of the tests themselves. Tests of school proficiency, reading, writing and arithmetic, may be just as mechanical as the tests we are describing. The ability required to solve the Dearborn Formboard may be intellectual, and the child at this age level who solves the problem which it presents certainly displays intelligence in a great many cases. Indeed such tests are carelessly referred to by many as "intelligence tests," but such a use of the term "intelligence" requires it to be so meaningful as to be meaningless. The Witmer Formboard is for the ten year old a test of efficiency. In truth, to determine what ability a given test is testing in an individual case and to give that ability a name which will be inclusive, restrictive and descriptive, intelligible to himself and others, is one of the most difficult, and also most important, tasks confronting the clinical psychologist.

The starred tests of the Stanford Revision of the Binet-Simon Intelligence Scale were used. A few exceptions, however, were made. At the nine year level the test of making change was substituted for the test involving the judgment of lifted weights for convenience in procedure and to save time. At the ten year level the audito-vocal memory span of six digits was substituted for the test of naming sixty words in three minutes, and for the same reason. At the fourteen year level the audito-vocal memory span of seven digits was substituted for the arithmetic test because an arithmetic test was already included in the battery.

The Arithmetic Test was based on an analysis of the subject

matter of Fifth Grade Arithmetic in a number of large school systems. It was composed of the following five problems: Add 2783, 9814, 5379 and 1647; Multiply 534 by 675; Divide 59706 by 31; Add $\frac{4}{7}$ and $\frac{1}{7}$; If a man buys an automobile for $3,000 and sells if for $1,800, how much does he gain or lose? These problems were printed on sheets of paper 8½ by 11 inches which allowed sufficient space for the child to make any calculations he might desire. The examples of the fundamental operations were not printed as given above but in the conventional arrangement for such problems. Each child was given a copy of these problems and allowed ten minutes in which to solve them.

When a child came to the examining room an individual face sheet was made out for him, and on this face sheet all the data were placed. Certain items of information were secured before the examination itself began. The child was asked his name, his age and his birthday. The age and birthday were not always given correctly, and the information supplied by the child was in all cases verified by the school cards. The child was also asked to give his father's occupation. With this information secured the actual testing proceeded. The school history, i.e., age upon entering school, grades repeated and grades skipped, was obtained from the school cards.

One examiner gave the Witmer Formboard, the Witmer Cylinders and the Dearborn Formboard and the three memory span tests. A second examiner gave the Binet-Simon test. Insofar as possible the tests were given in the order mentioned.

The first test presented to the child was the Witmer Formboard. This test presents no difficulty to the child at this age level, but it serves a most useful purpose in making the child accustomed to the testing method, and the ease of its solution inspires self-confidence. It is placed before the child and the examiner points to the test saying, "You see these blocks. I am going to take them out and put them up here, and then I want to see how fast you can put them back where they belong." The blocks are removed in a haphazard manner. The completion of the test, as has been suggested, is not a difficult problem, and in most cases the child is ready for the second trial within a very short time. For the second trial the blocks are removed in a standard manner in order to present exactly the same problem to each child. The blocks are placed in the tray in three neat piles.

The hexagon, the isosceles triangle, the semicircle and the star are placed on the first pile; the diamond, the oblong and the equilateral triangle are placed on the second; the square, the circle, the oval, and the cross on the third. While the examiner is removing the blocks as indicated he says to the child, "Now I am going to take the blocks out this way. I want to see if you can do it faster this time. You may use both hands if you want to. Go ahead." The time limit for the Witmer Formboard is five minutes. If the blocks are not replaced in that time the performance is scored a failure.

The Witmer Cylinders were next presented to the child. The child's attention is called to the test while the examiner says, "I am going to take these blocks out and put them in the center and I want you to put them back where they belong as quickly as you can." The time limit is five minutes, and if the blocks are not correctly placed in that time the performance is scored a failure. A little teaching is allowed, however. If the blocks are all put back but some are incorrectly placed and the time limit has not yet elapsed, the examiner asks, "Is that right?" In many cases the child already knows it is not right, but thinks the partial solution may satisfy the examiner, or he may have been hoping, as one might say, "to get away with it." Upon this question from the examiner the child usually attempts to change the blocks to their correct position. If he does not, the examiner says further, "No, that is not right. Fix the blocks so they are all level with the top." If this final suggestion is not sufficient to produce a correct solution within the time limit the child is taught how the test should be solved. In any case a second trial is given.

The Dearborn[3] Formboard has been described as #1c. The model of the board used in this investigation is smaller in size than the Dearborn Formboard in common use. The board measures 7⅝ inches by 11 inches, and the forms are approximately 1¾ by 3¾ inches. The dimensions are thus reduced by one-half, but the proportions of the larger board are maintained exactly. The smaller board is now used exclusively in the Psychological Clinic at the University of Pennsylvania. It is much more convenient to handle and to move about; the blocks, being smaller,

[3] Dearborn, W. F., Anderson, J. E., and Christiansen, A. O., *Formboard and Construction Test of Mental Ability*, Journal of Educational Psychology, 1916, vol. 7, pp. 445-458.

are more readily manipulated by younger children. Whether the smaller board is easier of solution than the larger has not been determined. The larger board was used in the investigation of the fifteen year level, but the same method of setting the problem was used in both that study and the present one. The four horizontal halves are removed, and four vertical halves are allowed to remain in the partly filled recesses of the board. When the board has been set in this manner the examiner points to the four blocks which have been removed and says to the child, "You see these four blocks. They belong back in this board; you may move these blocks in the board around any way you want to, but if you do it right all the blocks will fit back in the board and all the empty spaces will be filled."

Dearborn's original method of setting the board was to remove the horizontal halves of the diamond and the oval, and the vertical halves of the rectangle and the hexagon. This procedure left remaining in the unfilled recesses of the board horizontal halves of the hexagon and the rectangle, and vertical halves of the diamond and the oval.

The time limit allowed for this test was ten minutes. If the blocks were not placed in the board at the end of this time limit the performance was scored a failure, and the child was taught how to do the test. The teaching was always done with the minimum amount of instruction on the part of the examiner. In all cases two trials were given.

The tests of memory span followed, and in all cases the memory span was determined separately from the Binet. This was done because the series of digits given for the several tests of memory span at different age levels in the Binet are open to some objection. Digits occur in arithmetical sequence, and one digit sometimes occurs twice in the same series. Moreover the process of giving the Binet—the most time consuming test in the battery at best—is somewhat facilitated if the child's memory span is known before the test is begun.

The audito-vocal memory span forward was given first. The Humpstone series of digits and two modifications of it were used. These series are devised to eliminate the occurrence of numbers in forward or reverse arithmetical sequence and likewise numbers which would be likely to call forth any type of association. The standard procedure of Humpstone was followed. The exam-

iner said to the child, "I am going to say some numbers. Listen carefully and when I am through you say the numbers just the way I did. Remember, wait until I am through and say the numbers exactly as I said them." The digits were read at the rate of one per second, without rhythm or grouping. The test began with a series of three digits. If the child failed to repeat correctly a series of a given length he was given a second trial with another series of the same length. The score was the number of digits in the longest series repeated correctly.

The visuo-vocal memory span test followed the audito-vocal forward. The Stoelting cards were used. The examiner held the card before the child saying, "Now I want you to read these numbers, and after you have finished I will ask you to say the numbers." The test began with a series of four digits. The score was the number of digits in the longest series repeated correctly, only one trial being given at each length of series.

The last of the memory span tests was the audito-vocal reverse. For this test series of digits were employed which had not yet been used in the examination. The examiner said, "This time I want you to say the numbers backward." The concept of the reverse span is rather difficult for some children to grasp, and the instructions are given in greater detail. The examiner continued, "Do you understand? . . . . If I would say 1-3, what would you say?" The child in most cases responds correctly to this question and the examination may proceed. The method of scoring was the same as that used for the audito-vocal forward.

Treatment of Results

It has been pointed out earlier in this report that the subjects showed a very wide range in chronological age—from 8 years and 11 months to 17 years and 3 months to be exact. It seemed desirable to secure a group for special study which would be more homogeneous in chronological age and to do this without purely arbitrary selection. Such a group consisting of 60 per cent of all the children who had been tested was secured on Dr. Witmer's suggestion in the following manner. The mean of the chronological ages of the 500 cases was obtained, and the case which varied most from this mean was eliminated from the group. A new mean was then secured for the remaining 499 cases, and again the case varying most from the mean was eliminated. This procedure

was repeated two hundred times, and there remained 300 cases or 60 per cent of the original group. Of these 300 children 149 were boys and 151 were girls. Of the 200 cases removed from the group 28 came from the lower end of the chronological age distribution and 172 from the upper end. The median modal age group secured in this manner ranged in chronological age from 9 years and 8 months to 11 years and 4 months. These 300 cases were then treated statistically just as the original group of 500 had been treated and their results were separately tabulated. This group is called a median modal age group because through the manner of its derivation a group is secured which distributes closely about the median, and because it contains a majority of the cases in the original group. Inclusion in a median modal group of this type is what is commonly meant by the term "average."

At the end of the discussion will be found decile tables which represent the summarization of the results of the investigation arranged for diagnostic comparison so that they can be used to determine the relative superiority-inferiority of a given individual. The results of such a diagnosis can best be expressed by saying that the individual is in a group of *a* per cent superior to *b* per cent and inferior to *c* per cent. For example, a child who completes the Dearborn Formboard in two minutes is in a group of 10 per cent superior to 80 per cent and inferior to 10 per cent, that is, in regard to his performance on this one test.

Discussion of Results

The Witmer Formboard has been standardized previously[4] at the four year level; 50 per cent of children at the four year level would be expected to complete the test within five minutes, and 50 per cent would be expected to fail. To the four year old this test presents a new problem and its solution therefore demands intelligence. In the case of the ten year old the solution of the Witmer Formboard is a display of efficiency rather than a demonstration of intelligence. The results secured by the use of this test will have very little diagnostic value at the ten year level, but it is useful in helping the child to become adjusted to the testing process. The relatively easy solution of this test, which seems to be little more than an interesting game, wins the child's coopera-

[4] Young, Herman H. *The Witmer Formboard.* Psychological Clinic, 1916, vol. 10, pp.

tion and gives him some confidence in his ability to succeed in the competitions to follow. It was noted sometimes, however, that superior children were bored by the simplicity of the test and upon its completion looked up at the examiner rather disappointedly, as if to say, "Why don't you give me something hard?"

The results show that all of the children complete the test on the first trial in less than one minute, and only 2.6 per cent require more than forty seconds. Those children who did not complete the test so quickly in most cases became confused in the two triangles which, as previous investigators have pointed out, is the most difficult problem of the board. Since this is the first test in the series children often begin it under a good deal of stress and an anxiety to do well. Failure to place these blocks, should they be the first ones picked up, often leads to confusion and delay. On the second trial strangely enough three children required more than a minute to complete the test. This fact may be attributed to some confusion similar to the one mentioned above, or to an attempt to speed up when told to put the blocks away more quickly the second time. Then again some children of a playful and curious disposition are inclined to try odd and interesting but inefficient new ways of putting the blocks back.

Young found a slight sex difference in favor of the boys. Easby-Grave found a similar difference amounting to about two seconds at each decile. In our results the difference shown by the decile tables is even less, and the median is twenty-five seconds for both the boys and the girls. 49.6 per cent of the boys and only 42.4 per cent of the girls complete the test in less than twenty-five seconds. On the other hand a slightly larger number of girls than boys complete the test in less than twenty seconds. The sex difference does not appear to be a significant one for the Witmer Formboard.

Comparison with the results at the six year level shows a very marked difference in performance on this test. Of the First Grade children 2.6 per cent failed to complete the test in five minutes on the first trial while all of the Fifth Grade children, as we have pointed out, completed it in less than one minute. Easby-Grave thinks that the really superior performances among her subjects were those which required less than thirty seconds on the first trial and less than twenty seconds on the second trial. These superior performances amounted to 4.6 per cent on the first

trial and 1.6 per cent on the second. Turning to our own results we find that 46 per cent completed the test in less than thirty seconds on the first trial, and 36 per cent completed it in less than twenty seconds on the second trial.

The WITMER CYLINDERS[5] present much more of a problem for the ten year old. The number of failures among our subjects is low, but there is a very considerable range in the time required for the completion of this test. The qualitative differences while they cannot be treated or represented statistically are even greater. Many children solved this test the first time purely by trial and error, and some did not comprehend the problem even on the second trial. It must be remembered that a test of this kind may be solved by luck. These qualitative aspects of a performance are of great importance in a clinical examination.

This is a test at the six year level. Approximately 50 per cent of children at that level succeed in solving the test within five minutes and a similar number fail. Only 3.4 per cent of our subjects failed within this time limit. The reduction in number of failures is very striking. 70.6 per cent of the subjects complete the Witmer Cylinders in less than two minutes and after that the results show a great deal of scattering. It seems to the writer that two minutes should be the time limit for this test with ten year olds.

Only one child, a boy, failed to solve this test on the second trial as against 12 per cent of the children at the six year level. This failure, being the only one in 500 cases, deserves special notice. The boy was 9 years and 7 months old and thus up to grade if not slightly accelerated in school. This school progress is somewhat surprising for his Intelligence Quotient was only 86. He had an audito-vocal memory span of five and a reverse memory span of three. He failed the Cylinders on both trials and solved the Dearborn Forboard in four minutes and six seconds on the first trial, and four minutes and twenty-eight seconds on the second trial. His score on the Arithmetic Test, the only measure of school proficiency we had, was 80. This is superior to 50 per cent of the group. It is a matter of regret that a qualitative analysis of his performance on the Cylinders cannot be given. He was tested early in the investigation and his failure excited no remark since it was expected that a number of children would fail similarly.

[5] PASCHAL, F. C. *The Witmer Cylinders*, 1918, The HERSHEY PRESS Co., Hershey, Pa.

There is, as previous investigators have found, a sex difference in favor of the boys. Only 1.2 per cent of the boys fail to complete the test while 5.6 per cent of the girls, or more than four times as many, fail. The difference is equally significant for the superior performances. The really superior performances on the Witmer Cylinders at this age level are those which require less than one minute. This group would include 28.8 per cent of the boys and 16.4 per cent of the girls. The difference is maintained on the second trial. Here 63.6 per cent of the boys solve the test in less than one minute as against 47.6 per cent of the girls.

The results for this test at the fifteen year level are not in a form which makes them so readily comparable. The median for the males of the entire group at that level is 55 seconds, and for the females it is 68 seconds. In our study the median for the males is 75 seconds and for the females it is 80 seconds. In the High School group at the fifteen year level the median for the males is 52 seconds, and for the females, 71 seconds. It will be observed that the median for Fifth Grade boys is just four seconds higher than the median for the High School girls.

The Dearborn Formboard, according to Leaming,[6] is a real intelligence test at the fifteen year level, and so it is certainly a test of intelligence for ten year olds. As a matter of fact, when this test was introduced into the battery for the present investigation, it was not expected that so many children would complete it within the time limit. The problem which this test presents is much more difficult that the problem of the Witmer Cylinders. One factor, however, makes it a slightly different test—it is self-corrective. The blocks will not go into the Dearborn Formboard in any way except the right way while the Cylinders can be replaced in all sorts of wrong ways. The instructions which can be given for the Cylinder test when the blocks are misplaced obviate to a certain extent this difference. After observing a large number of children working on this test it is the opinion of the writer that one of the most important factors in making this a more difficult test than the Witmer Cylinders is the problem of the third dimension. It makes no difference which end of a cylinder is placed in the recess first, while the turning of a block over instead of around is often the one necessity for success in solving the Dearborn. The two forms which cause the most trouble for the

[6] *Op. cit.*, p. 199.

child in solving the Dearborn Formboard are the hexagon and the diamond, which difficulty is partly due to the factor of discrimination. The most difficult of all the forms in this test is the diamond, particularly the problem of placing the two right angled triangles in such a position as to fill out the equilateral triangle which is half of the diamond. Many children fail to place these small triangles simply because they keep turning them around in two dimensions. If they once get the concept of turning the blocks in the third dimension this most difficult problem is usually solved. The introduction of an additional dimension complicates a problem very considerably. The futility of most attempts to elucidate the concept of the fourth dimension and the difficulty which even superior minds experience in its comprehension substantiate this statement without further comment.

Of the entire group 9.2 per cent fail to complete the Dearborn Formboard within the time limit of ten minutes. On the second trial this number is reduced to 2.8 per cent. The time limit of ten minutes seems to be too long. The test becomes a very time consuming one especially if the subject fails on both trials. Moreover with such a long time limit there is a larger opportunity for solutions by luck. One of the examiners noted in regard to a solution which was completed in something over six minutes, "Qualitatively the poorest performance I have ever seen." Five minutes gives ample opportunity for the child who really can solve the test to do so, and it also provides a performance long enough for the examiner to reach his conclusions. If the time limit were reduced to five minutes 30.4 per cent of our subjects would fail on the first trial and 8 per cent on the second trial. The test is still too easy of solution to be called a test at the ten year level as the Witmer Cylinder Test is at the six year level. Perhaps it is a test at the nine year level, but that is purely a matter of conjecture.

The Dearborn Formboard was of course not given at the six year level when norms for that age were being established. A comparison with the results at the fifteen year level is possible, however. At that level the median for the males is 125 seconds, and for the females it is 190 seconds. These results are for the entire group. In the High School group the median for the males is 109 seconds, and for the females, 176 seconds. The median for the males in our investigation is 181 seconds, and for the fe-

males, 244 seconds. The difference between the two levels is not as great as might be expected. The median for the boys at the ten year level is less than the median for the girls at the fifteen year level. When the sexes are compared separately the difference amounts to about one minute. This is for the median, at higher and lower deciles the difference is less marked.

Within our own results the sex difference is more pronounced than in any of the previous tests. There were more than three times as many failures among the girls, 14.4 per cent, as against 4 per cent. If the time limit were reduced to five minutes 24 per cent of the boys and 36.8 per cent of the girls would fail. As far as actual failures are concerned the sex difference is more pronounced for the Witmer Cylinders, but for the other levels of the distribution the difference is greater for the Dearborn. The median in time for the Cylinders is 75 seconds for the boys and 80 seconds for the girls. There is an increase of 6.7 per cent in time for the girls. On the Dearborn the median for the boys is 181 seconds and for the girls 244 seconds, an increase of 34.8 per cent. The medians on the Witmer Formboard are the same for both boys and girls. The differences which have been mentioned are fairly consistent throughout the decile distribution.

Sex differences such as those found in this investigation and in others should be explained if possible. Attempts toward such explanation have been made on the ground that the type of material used in this kind of test is more familiar to boys than to girls. These tests are made up largely of blocks and boys play with blocks while girls play with dolls, and so on. It may well be that this factor plays some rôle in producing the results which we have observed, but there remain other facts to be answered. The sex difference seems to increase with the difficulty of the test; it is least for the Witmer Formboard, more for the Witmer Cylinders, and most of all for the Dearborn Formboard. Surely the Witmer Cylinder test is no less "masculine" than the Dearborn Formboard. An analysis of our results would lead to the following summarization: In the three tests of our battery which are independent of language ability and whose solution depends upon efficiency or intelligence, as the case may be, the less efficiency and the more intelligence required for a superior performance, the greater is the sex difference in favor of the boys. Whether this summarization represents a universal or a general situation is quite another matter, but it does demand consideration.

Memory Span

The writer plans to publish subsequently a paper devoted to the analysis of the memory span test results. The discussion of these results is therefore somewhat abbreviated here.

When the results of the memory span tests in the present investigation are compared with the results of the six year level significant differences are noted. The greatest difference is in the visual-vocal memory span, the next greatest is in the reverse, and the least of all is in the audito-vocal. 92.2 per cent of our subjects have a visual-vocal memory span of six or more while only 15 per cent of the children at the six year level have spans of six or more. At the six year level Easby-Grave found the audito-vocal memory span consistently one higher than the visual span. In the results at the ten year level the situation is reversed. The visual span is consistently one higher than the auditory and sometimes it is two higher. The higher audito-vocal memory span at the six year level is no doubt due to the fact that the six year old finds the mere reading of the numbers to involve considerable mental effort. By the time children have reached the Fifth Grade the reading of the numbers is of course automatic. The visual memory span test is subject to a number of factors. In the first place it is extremely difficult to control the speed at which the child reads the digits; he will outrun the speed of the examiner's pencil or again perhaps stop to go back and look at a digit that has been passed. Superior children invariably group in reading the digits, but perhaps that does not make so much difference since the task is merely to repeat the digits. In the performances of life there is no law against grouping. Any attempt to compare the visual and auditory memory spans as giving an indication of the relative degree of perseveration in the different sense modalities must fail because in the visual test the entire series of digits is present at one time while in the auditory it is not. Moreover in the visual memory span test the auditory and kinæsthetic fields are stimulated as well as the visual. To turn finally to the fifteen year level it is seen that there too the visual memory span, as we might expect, is higher than the auditory. At least 40 per cent of the subjects at the fifteen year level have a visual span of more than 8 while only 6.4 per cent of our subjects have spans of that length. These last are the really superior visual memory spans at the ten year level.

The reverse memory span test was given at the six year level but not at the fifteen. Of the six year olds 42.4 per cent failed to comprehend the concept of the reverse. None of our subjects failed and only 1.4 per cent secured a reverse memory span of 2 as against 18.8 per cent at the six year level. Only 7.8 per cent of the six year olds had a reverse span of more than three while 70.8 per cent of the ten year olds had reverse spans of that length. The explanation of this difference is more complicated than the explanation given for the difference in visual span. It is the belief of the writer that the reverse memory span is representative of intellectual complexity, that is, of the level of intellectual organization.[7] In the attempt earlier in this report to differentiate the ten year level it was said that the great difference between the six and ten year levels was that of intellectual organization.

The really superior performances in audito-vocal memory span among our subjects are those of more than six, 17.2 per cent. At the six year level 9.6 per cent of these cases had such memory spans. This difference, while it is a significant one, is not as great as the differences in the other memory span tests. At the lower end of the distribution the difference between the two levels is more pronounced. Only one of our subjects had an audito-vocal memory span of three while 3.8 per cent of the six year olds had a span of three. The really inferior audito-vocal memory spans at the ten year level are those of less than five, 5.2 per cent. At the six year level 33.2 per cent of the children had audito-vocal memory spans of less than five.

At the fifteen year level at least 70 per cent of the cases had an auditory memory span of more than six, and less than 1 per cent had an auditory span of less than five.

The one case with an audito-vocal memory span of three deserves special notice. It is commonly believed that a memory span of three at this age level is of itself an indication of feebleminded-ness, and indeed most of the children having such spans as they are seen in the psychological clinic, are feebleminded. The child in question was a boy 10 years and 8 months old doing satisfactory work in school. He had an Intelligence Quotient of 90 and completed the non-verbal performance tests in approximately the median time. Because of the theoretical importance of this case the

[7] This contention was advanced by Anna Spiesman Starr (see bibliography) and seems to be supported by our results.

boy was given a more thorough examination several weeks after he first took the tests. Out of six trials of four digits he repeated only one correctly. His span was undoubtedly three. He was certainly not feebleminded on the scale of social competency. He had never been compelled to repeat a grade in school. On the basis of his school work, his performances on the tests and his general orientation the examiner could find no ground for diagnosing him as feebleminded on the intellectual scale. He will very probably not succeed in High School but if that is the criterion of intellectual normality the number of feebleminded is legion.

We must be careful to differentiate between an individual's true memory span and the span which he seems to demonstrate in a test. His true span is the number of discrete units which he can comprehend in a single moment. When elemental units are grouped into more comprehensive units they cannot be said to be grasped as discrete units. By this criterion none of our subjects had memory spans of eight or nine. In a recently published paper Oberly[8] describes an investigation in which he employed a method of testing similar to our own and found adults giving memory spans of twelve and fourteen. The observers all agreed that such high results were obtained only by grouping. It may well be that many of our subjects at the ten year level did not have true spans of more than three. This one boy happened to give a test span equal to his true span.

Binet-Simon Test

The following tables show first the basal age for all of the subjects, and second the number of children passing each test in the

Table 1. Basal Age.

Basal Age.	Males	Females	Total
6	0	4	4
7	6	11	17
8	49	51	100
9	82	93	175
10	105	82	187
12	7	9	16
14	1	9	10

[8] Oberly, H. S. *A Comparison of the Spans of "Attention" and Memory.* American Journal of Psychology, 1928, vol. 40, 295-302.

TABLE 2.

Age Level	Test No.	Males	Females	Total
VII	1	250	250	500
	2	250	250	500
	5	250	246	496
	6	250	250	500
VIII	2	249	248	497
	3	249	247	496
	4	245	240	485
	6	249	246	495
IX	1	243	244	487
	3	250	244	494
	4	199	192	391
	5	249	245	494
X	1	219	182	401
	2	231	210	441
	5	202	186	388
	6	144	140	284
XII	1	88	42	130
	4	124	110	234
	5	157	129	286
	6	31	47	78
	7	131	112	243
	8	126	110	236
XIV	1	13	2	15
	3	15	4	19
	4	68	34	102
	5	42	39	81
XVI	1	0	0	0
	2	30	22	52
	4	22	11	33
	5	2	7	9
XVIII	1	0	0	0
	3	5	6	11
	4	0	2	2
	5	0	0	0

entire series. It is apparent that the tests of a given age level are not of equal difficulty. At the Nine Year Level the reverse memory span of four is very much more difficult than the other tests, so much more difficult in fact that nearly one hundred less children pass it than any other test. The same thing is true for the audito-vocal memory span forward at the Ten Year Level. At the Twelve Year Level the vocabulary test and the reverse memory span of five are the most difficult tests. In as much as these subjects are not twelve year olds we cannot speak critically of the relative difficulty of the tests above the ten year level. It does seem, however, that the memory span tests in the Binet are not properly placed in respect to the other tests.

The mental age is at each decile in the distribution about two months less than the chronological age, and the median for the Intelligence Quotient is 99.3, just a slight variation from what it should be theoretically. At the six year level the median Intelligence Quotient was 105, and at the fifteen year level it was 102 for the boys and 97 for the girls. It is natural to expect that the Intelligence Quotients for ten year olds will not be as high as those for six year olds. In order to obtain a high Intelligence Quotient a ten year old must pass tests at the Twelve Year Level. It is conceivable that if there were tests at the Eleven Year Level in the Binet-Simon scale of intermediate difficulty a ten year old child might pass all of those tests and secure a mental age of eleven and a correspondingly high Intelligence Quotient. As it is he may fail all of the tests of the Twelve Year Level and have a mental age of only ten and a relatively low Intelligence Quotient. Moreover the six year old has many more tests to attempt above his age level than the ten year old, and merely from the mathematics of it a mental age of one year higher than the chronological age adds more to the Intelligence Quotient at six than it does at ten.

The term "mental age" is used here merely to mean the total score of tests passed in the Binet-Simon scale. The term is often employed in a misleading manner when a mental age of ten years is construed to mean the mental age of the average ten year old. A child with a mental age of ten years is supposed to have the mental development of the average ten year old provided he passes the tests in the Binet-Simon scale to give him such a mental age whether his chronological age is eight or eighteen. Among the five hundred children tested in this investigation there was a boy

ten years and three months of age who had a mental age of exactly sixteen years. A colored boy who was sixteen years and eleven months of age had a mental age of ten and one-half years. To say that the first boy had the mental development of the average sixteen year old is to use the term in a sense so restricted as to be confusing if not useless. It is just as erroneous to say that the boy who was sixteen years old—almost seventeen in fact—had a mental development equivalent to that of the average ten or eleven year old boy. What these results show is that the first boy did about as well on the Binet-Simon test as the average sixteen year old, and that the second boy did about as well as the average child who is ten and one-half years old. Beyond that the results mean nothing.

This whole problem was brought out in a conversation with the principal of one of the schools in which the investigation was carried on. He was a man of experience and discernment, and somewhat suspicious of the nostrum of mental testing. He had just given to his Eighth Grade a group test which employed the concept of mental age. In this test he found some twelve year old children, accelerated in school and very probably of superior intellectual ability, who had a mental age of sixteen. In the same grade were some children sixteen years of age, retarded in school and probably of inferior intellectual ability, who, according to the test, had a mental age of twelve. The principal thought he knew something about these children, and what he knew was that the twelve year olds did not have the mental development of the sixteen year olds, to say nothing of the superior mental development indicated by the test. He thought that the sixteen year olds in spite of their inferior performance on the test had an attitude toward their work and toward life, and had a grasp on the practical problems of life which the younger children did not have regardless of their superior work on the test. He meant that the older children had a different orientation. What the principal knew, anyone who is acquainted with the facts of mental development knows, namely that between twelve and sixteen years of age the individual undergoes the most profound changes in motivation which cannot help but influence all the factors in mental growth. To leave such factors out of the concept of mental age just because they are difficult of testing is to restrict one's self dangerously. While these factors of motivation cannot be tested

adequately the experienced examiner using the clinical method may discern and evaluate them.

Arithmetic Test

In scoring the Arithmetic Test twenty points were allowed for each problem solved correctly. If the method was correct but a minor error was made in calculation fifteen points were allowed; a gross error in calculation reduced the score for the problem to ten points. No credit was allowed where the method of solving the problem was incorrect. There were five problems in the tests and thus the total possible score was 100. An analysis of the results for the several problems reveals the following: 350 solved the addition problem without error; 257, the multiplication; 163, the division; 308, the addition of fractions; 234, the reading problem. These results are for solution securing a score of twenty points. It is seen that the division problem was the most difficult. All manner of methods were used in attacking this problem. The results in all of the problems are not very gratifying.

The Median Modal Age Group

In the discussion of the treatment of results it was explained that a median modal age group of 300 children was secured in an objective manner. The test results for this group have been tabulated separately. An analysis of these results and the respects in which they differ from the results of the entire group would seem useful. The analysis, however, will be brief because the differences do not seem significant or instructive for the most part.

The median modal age group is one from which most of the children who were retarded in school have been eliminated. Of the 200 cases eliminated in the manner previously described 172 were over age for grade and only 28 were under age. The median modal age group represents, therefore, largely the group who have made the average school progress. The ability required for success in school is intellect—the ability to acquire, retain, organize and use knowledge, as Dr. Witmer has defined it. If we have in our series of tests any which test this ability we should find the median modal age group superior. The test in the battery which upon pre-analytic judgment would be most likely to detect differences in intellectual ability is the Binet-Simon, and consequently it should be called a test of intellect rather than a test of intelli-

gence. As a matter of fact it can be seen referring to the tables that the greatest difference between the median modal age group and the group as a whole is in this test. 48.4 per cent of the entire group have an Intelligence Quotient of 100 or more which, according to the theory underlying this test, is what should be expected or approximately that. In the median modal age group, on the other hand, 65 per cent of the cases have an Intelligence Quotient of 100 or more.

In the test of non-verbal performance—the Witmer Formboard, the Witmer Cylinders, and the Dearborn Formboard—the differences between the two groups are very small. In memory span there is a small but consistent difference in favor of the median modal age group. For example, those having an audito-vocal memory span of more than five number 56.8 per cent in the entire group and 63 per cent in the median modal age group. Of the entire group 13.8 per cent have a reverse span of more than four, in the median modal age group this number is increased to 17 per cent.

Conclusions

1. The ten year age level shows significant differences when compared with the six year level and the fifteen year level.

2. The most pronounced sex differences are found in the results for the Witmer Cylinders and the Dearborn Formboard.

3. The time limit of ten minutes for the Dearborn Formboard is too long and allows too great an opportunity for chance solutions. It should be reduced to five minutes thus conforming in time limit to the other two tests.

4. The Dearborn Formboard is clearly a test at this age level and perhaps even earlier.

5. Pedagogical retardation is very marked in the group tested. Twenty per cent are more than one year over age for grade, i.e., twelve or more years old.

6. In the median modal age group of 60 per cent most of these over-age pupils are eliminated. This group is superior to the entire group in Intelligence Quotient, but not in no-verbal performance tests.

Bibliography

Dearborn, W. F., Anderson, J. E., Christiansen, A. O. *Formboard and Construction Tests of Mental Ability.* Journal of Educational Psychology, 1916, 7, 445-458.

EASBY-GRAVE, CHARLOTTE. *Tests and Norms at the Six Year Old Performance Level.* PSYCHOLOGICAL CLINIC, 1924, 15, 261-300.

HUMPSTONE, H. J. *Some Aspects of the Memory Span Test—A Study in Associability.* PSYCHOLOGICAL CLINIC PRESS, Philadelphia, 1917.

HURLEY, DE WEERT, A. ESTHER, *Study of the Improvability of 5th Grade School Children in Certain Mental Functions.* JOURNAL OF EDUCATIONAL PSYCHOLOGY, 1927, 18, 547-557.

IDE, GLADYS G. *The Witmer Formboard and Cylinders as Tests for Children Two to Six Years of Age.* PSYCHOLOGICAL CLINIC, 1918, 12, 65-88.

LEAMING, R. E. *Tests and Norms for Vocational Guidance at the Fifteen Year Old Performance Level,* PSYCHOLOGICAL CLINIC, 1924, 15, 261-300.

PASCHAL, F. C. *The Witmer Cylinders,* HERSHEY PRESS, Hershey, Pa.

STARR, ANNA SPIESMANN. *The Diagnostic Value of the Audito-Vocal Digit Memory Span,* PSYCHOLOGICAL CLINIC, 1923, 15, Nos. 3-4.

SYLVESTER, R. H. *The Formboard Test.*

TERMAN, L. M. *Measurement of Intelligence,* HOUGHTON MIFFLIN CO., 1916.

YOUNG, H. H. *Physical and Mental Factors Involved in the Formboard Test.* PSYCHOLOGICAL CLINIC, 1916, 10, 149-167.

WITMER, LIGHTNER. *The Relation of Intelligence to Efficiency.* PSYCHOLOGICAL CLINIC, 1915, 9, 61.

Ibid. Efficiency and Other Factors of Success. PSYCHOLOGICAL CLINIC, 1919, 12, 241.

Ibid. Intelligence—A Definition. PSYCHOLOGICAL CLINIC, 1922, 14, 65.

Ibid. Psychological Diagnosis and the Psychonomic Orientation of Analytic Science. PSYCHOLOGICAL CLINIC, 1925, 16, 1.

TEN YEAR LEVEL—ENTIRE GROUP. 500 CASES.

C.A.	M.A.	%	I.Q.	M.S. Aud.	M.S. Vis.	M.S. Rev.	Witmer Fb. I	Witmer Fb. II	CYL. I	CYL. II	Drbn. Fb. I	Drbu. Fb. II	Arith
17-3	16-0	100	156.1	9	10	6	12	12	32	24	41	35	100
15-2	14-5	99	137.7	8	9	6	16	13	39	30	55	38	100
12-11	12-6	90	119.9	7	8	5	19	16	49	40	96	57	95
12-1	11-9	80	112.6	6	8	4	21	18	57	45	125	70	90
11-6	11-4	70	107.1	6	7	4	22	19	64	50	145	83	85
11-1	10-11	60	103.0	6	7	4	23	20	69	53	174	95	80
10-10	10-8	50	99.3	6	7	4	25	21	77	57	209	106	70
10-7	10-5	40	94.9	5	7	4	26	22	87	60	253	126	65
10-4	10-2	30	89.6	5	6	4	28	23	98	65	304	153	60
10-1	9-10	20	84.6	5	6	3	30	25	126	71	378	194	50
9-10	9-6	10	77.2	5	6	3	35	28	183	83	580	264	40
9-2	8-3	1	61.2	4	5	2	46	57	F	146	F	F	10
8-11	7-3	0	54.0	3	5	2	51	93	F	F	F	F	0

TEN YEAR LEVEL—MALES. 250 CASES.

C.A.	M.A.	%	I.Q.	M.S. Aud.	M.S. Vis.	M.S. Rev.	Witmer Fb. I	Witmer Fb. II	CYL. I	CYL. II	Drbn. Fb. I	Drbn. Fg. I	Arith.
17-3	16-0	100	156.1	8	10	6	15	12	35	24	41	35	100
15-9	14-5	99	138.4	8	9	5	16	13	36	30	46	38	100
13-0	12-9	90	122.1	7	8	5	20	16	47	39	85	53	95
12-2	11-11	80	114.3	6	8	4	21	18	53	43	115	67	90
11-7	11-6	70	108.5	6	7	4	21	19	60	46	132	78	85
11-3	11-1	60	103.8	6	7	4	23	20	65	50	151	88	80
10-11	10-9	50	100.1	6	7	4	25	21	75	54	181	100	70
10-7	10-6	40	94.6	5	7	4	26	22	84	58	219	119	65
10-6	10-4	30	89.9	5	6	4	28	23	93	61	265	139	60
10-3	10-1	20	85.7	5	6	3	30	25	111	68	344	180	50
9 11	9-7	10	79.5	5	6	3	35	27	166	76	492	235	35
9 2	8-6	1	61.8	4	5	2	46	57	F	146	F	552	10
8-11	8-3	0	54.6	3	5	2	51	93	F	F	F	F	0

TEN YEAR LEVEL—FEMALES. 250 CASES.

C A.	M.A.	%	I.Q.	M.S. Aud.	M.S. Vis.	M.S. Rev.	Witmer Fb. I	Witmer Fb. II	CYL. I	CYL. II	Drbn. Fb. I	Drbn. Fb. II	Arith
15-9	14-4	100	151.3	9	10	6	12	12	32	29	59	37	100
15-2	13-11	99	135.0	8	9	6	16	14	42	30	71	41	100
12-9	12-2	90	118.4	7	8	5	19	17	55	42	115	61	95
11-11	11-4	80	109.9	6	8	4	21	17	61	48	135	75	90
11-5	11-1	70	106.0	6	7	4	22	19	67	52	166	89	85
11-0	10-9	60	102-3	6	7	4	24	20	73	54	193	101	80
10-8	10-8	50	98.7	6	7	4	25	20	80	60	244	112	75
10-6	10-3	40	95.1	5	7	4	26	21	91	63	293	133	70
10-3	9-11	30	89.1	5	6	4	28	23	111	68	350	161	60
10-0	9-7	20	83.3	5	6	3	30	25	145	73	396	216	55
9-8	9-1	10	75.5	5	6	3	35	29	213	88	F	304	40
9-2	8-0	1	61.2	4	5	3	43	49	F	132	F	F	15
9-0	7-3	0	54.0	4	5	2	49	72	F	282	F	F	10

TEN YEAR LEVEL—60 PERCENT MEDIAN-MODE. 300 CASES

C.A.	M.A.	%	I.Q.	M.S. Aud.	M.S. Vis.	M.S. Rev.	Witmer Fb. I	Witmer Fb. II	C YL. I	CYL. II	Drbn Fb. I	Drbn Fb. II	Arith
11-4	16-0	100	156.1	9	10	6	15	13	32	29	46	35	100
11-4	14-1½	99	139.9	8	9	6	16	14	42	31	85	38	100
11-1	12-9½	90	122.8	7	8	5	20	16	52	42	92	55	100
10-11	11-11	80	116.2	7	8	4	21	18	60	47	125	70	90
10-9	11-5	70	111.0	6	7	4	23	19	66	51	140	82	85
10-7	11-1	60	107.2	6	7	4	24	20	73	54	171	94	80
10-6	10-9	50	104.0	6	7	4	25	21	79	57	207	106	75
10-4	10-8	40	101.3	6	7	4	26	22	88	61	244	128	70
10-2	10-4	30	98.3	5	7	4	28	23	98	65	298	150	60
10-0	10-0	20	94.9	5	6	3	30	25	126	71	375	190	50
9-11	9-7	10	89.0	5	6	3	35	29	177	83	565	268	40
9-8	8-6	1	78.3	4	5	2	45	49	F	146	F	F	10
9-8	7-3	0	71.3	3	5	2	49	70	F	F	F	F	0